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Mg^{2+} Enhances the Formation of 2′,3′-cGMP, an Intermediate of RNA Cleavage by Binase

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Abstract

© 2016, Springer Science+Business Media New York.Binase, the ribonuclease secreted by Bacillus pumilus, is an endonuclease that cleaves the phosphodiester bond between the 3′-guanyl residue and 5′-OH residue of an adjacent nucleotide, with the formation of a corresponding intermediate, 2′,3′-cGMP on the first stage of a catalytic reaction. Binase possesses selective antitumor effect and induces apoptosis of lung carcinoma A549 cells. It was shown that the 2′,3′-cGMP messenger could exist in the reaction mixture over an hour. Furthermore, the addition of divalent non-transition metal Mg2+ increases the level of 2′,3′-cGMP formed by binase and that could be associated with the stabilization of RNA tertiary structure by this metal. It has been shown that exogenous 2′,3′-cGMP does not induce apoptosis of A549 cells, which are sensitive to binase. However, taking into account the cell-penetrating ability of binase, it can be concluded that 2′,3′-cGMP contributes to apoptogenic binase action only when it is formed intracellularly.

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Keywords

2′,3′-cGMP, A549, Binase, Cycle-forming guanyl-preferring RNases, Human lung carcinoma, Mg 2+, RNA structure stabilization

References

[1] Yoshida, H. (2001). The ribonuclease T1 family. Methods in Enzymology, 341, 28–41.

[2] Mitkevich, V., Ilinskaya, O., Makarov, A. (2015). Antitumor RNases: killer's secrets. Cell Cycle, 14, 931–932.

[3] Ilinskaya, O., & Shah Mahmud, R. (2014). Ribonucleases as antiviral agents. Molecular Biology, 48, 615–623.

[4] Takahashi, K., & Moore, S. (1982). The enzymes. Nucleic acids (B), 15, 435–467.

[5] Ulyanova, V., Khodzhaeva, V., Dudkina, E., Laikov, A., Vershinina, V., Ilinskaya, O. (2015). Preparations of bacillus pumilus secreted RNase: one enzyme or two. Microbiology, 84, 490–496.

[6] Sokurenko, J., Zelenikhin, P., Ulyanova, V., Kolpakov, A., Muller, D. (2015). Identification of 2′,3′-cGMP as an intermediate of RNA catalytic cleavage by binase and evaluation of its biological action. Russian Journal of Bioorganic Chemistry, 41, 37–43.

[7] Ilinskaya, O., Zelenikhin, P., Petrushanko, I., Mitkevich, V., Prassolov, V. (2007). Binase induces apoptosis of transformed myeloid cells and does not induce T-cell immune response. Biochem Biophys, 361, 1000–1005.

[8] Pan, T., Long, D., Uhlenbeck, O. (1993). Divalent metal ions in RNA folding and catalysis (pp. 271–302). New York: The RNA world, Cold Spring Harbor Laboratory Press.

[9] Stefan, L., Zhang, R., Levitan, A., Hendrix, D., Brenner, S., Holbrook, S. (2006). MeRNA: a database of metal ion binding sites in RNA structures. Nucleic Acids Research, 34, 131–134.

[10] Fallahian, F., Karami-Tehrani, F., Salami, S., Aghaei, M. (2011). Cyclic GMP induced apoptosis via protein kinase G in oestrogen receptor-positive and -negative breast cancer cell lines. The FEBS Journal, 278, 3360–3369.

[11] Kumazoe, M., Sugihara, K., Tsukamoto, S., Huang, Y., Tsurudome, Y., Suzuki, T., et al. (2013). 67-kDa laminin receptor increases cGMP to induce cancer-selective apoptosis. Journal of Clinical Investigation, 123, 787–799.

[12] Cabrera-Fuentes, H. A., Aslam, M., Saffarzadeh, M., Kolpakov, A., Zelenikhin, P., Preissner, K. T., et al. (2013). Internalization of Bacillus intermedius ribonuclease (BINASE) induces human alveolar adenocarcinoma cell death. Toxicon, 69, 219–226.